Optical Microscopy as Applied to Fabrication of Atomic-Scale Devices

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The official link for this solicitation is: http://www.grants.gov/web/grants/view-opportunity.html?oppId=275010

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Department of Commerce

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Description:

NIST seeks development of an optical imaging system that has micrometer resolution, an image field of 50 to 200 micrometers, and a depth of focus that ensures image quality over the field of view of interest. Such a system must have a working distance of nominally 20 cm, image an object that is in vacuum, and potentially have flexibility to work around obstructed sight paths.

To set the context, NIST is interested in developing new methods to fabricate atomically precise electronic devices. One of the primary challenges in this field, however, is in connecting these atomic-scale devices to macroscopic electrical contacts, enabling external measurement and additional fabrication steps. A new advance that links the atomic scale fabrication to macroscopic processes via imaging and fiducial markings is needed. Ideas for solving this challenge include stereo microscopy, a through-focus 3-D image reconstruction capability, and vacuum-compatible optical imaging. A product developed under this subtopic should be marketable as a tool for those doing research in atomic-scale devices, and ultimately in their commercial production.

The goal is to develop a solution to locating 50 nm sized features relative to larger fiducial markings, enabling future measurement and process steps on tools such as an SEM-based, e-beam lithography system. The objective is to design an imaging system that enables the relative position of near

atomic scale features and their local contacts to be accurately determined to several nanometers of overlay. Numerous users of scanning tunneling microscopy (STM) systems will benefit from this desperately needed capability. The project should demonstrate the concept (in Phase I) as well as develop a working prototype system (in Phase II) capable of being implemented in a vacuum system with an STM. The prototype must be the basis for an actual system to be developed and sold commercially to the STM and atomic-scale device fabrication communities.

Phase I activities and expected results:
Demonstration of a concept that clearly allows optical imaging of an STM tip and its relative position to optically visible fiducial markings. The system must allow the tip position to be accurately estimated relative to fiducial markings.

Phase II activities and expected results:
Development of a prototype system as defined in Phase I.

NIST will collaborate using its STM Ultra-High Vacuum facilities to help in the design and testing.

References:
1. Fuechsle, Martin, et al. *A Single Atom Transistor*, Nature Nanotechnology, Vol. 7, p. 242 (2012).

2. Morton, John, et al. *Embracing the Quantum Limit in Silicon Computing*, Nature 479, p. 345 (2011).